United States Patent [19]

Winkler

[11] **3,794,957**

[45] **Feb. 26, 1974**

[54] **PLURAL-POLED, GENDERLESS ELECTRICAL CONNECTOR**

[75] Inventor: **Edward D. Winkler,** Reading, Mass.

[73] Assignee: **Anderson Power Products, Inc.,** Boston, Mass.

[22] Filed: **Jan. 22, 1973**

[21] Appl. No.: **325,448**

[52] **U.S. Cl.** ..... **339/49 R,** 339/31 R, 339/184 R

[51] **Int. Cl.** **H01r 25/00**

[58] **Field of Search** 339/47–49, 45, 339/46, 184, 186, 31–33

[56] **References Cited**

UNITED STATES PATENTS

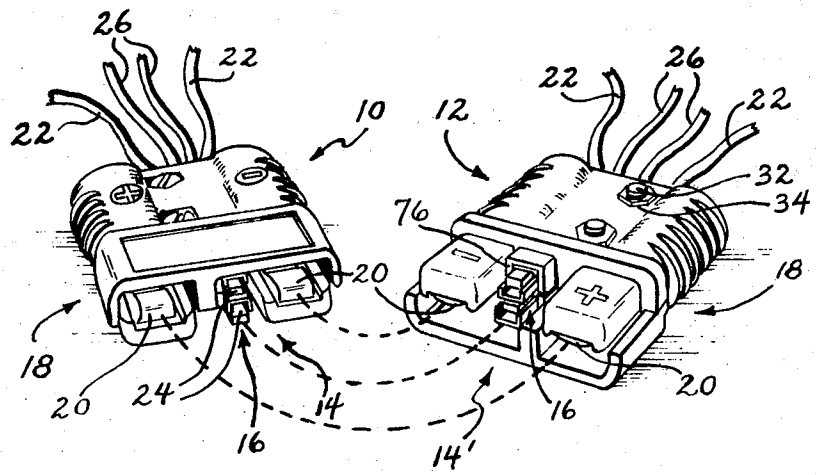
3,688,243	8/1972	Yamada et al.	339/49 R
482,306	9/1892	Hall	339/49 R
3,091,746	5/1963	Winkler	339/47 R
3,611,274	10/1971	Katzin	339/278 M
3,289,145	11/1966	Ruehlemann et al.	339/31 R X

Primary Examiner—Marvin A. Champion
Assistant Examiner—Terrell P. Lewis
Attorney, Agent, or Firm—Chittick, Thompson & Pfund

[57] **ABSTRACT**

A plural-poled, genderless electrical connector having main and auxiliary contacts which telescopically engage with counterpart contacts on an identical connector. The contacts are arranged to provide a make first-break last electrical connection sequence for the main contacts and a make last-break first electrical contact sequence for the auxiliary contacts. A staggered peak insertion force load is obtained from a predetermined physical placement of the contacts within the connector.

9 Claims, 11 Drawing Figures



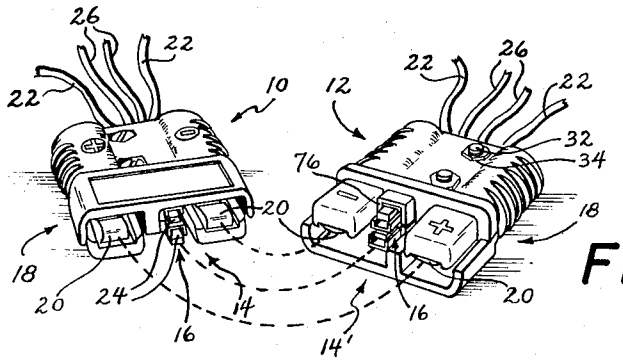


FIG. 1

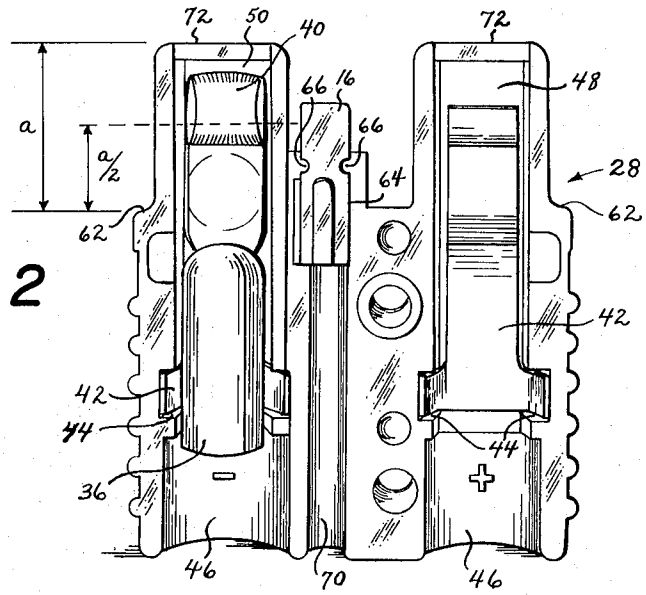


FIG. 2

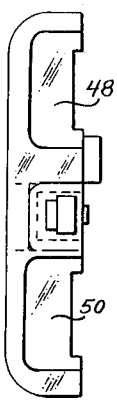


FIG. 3b

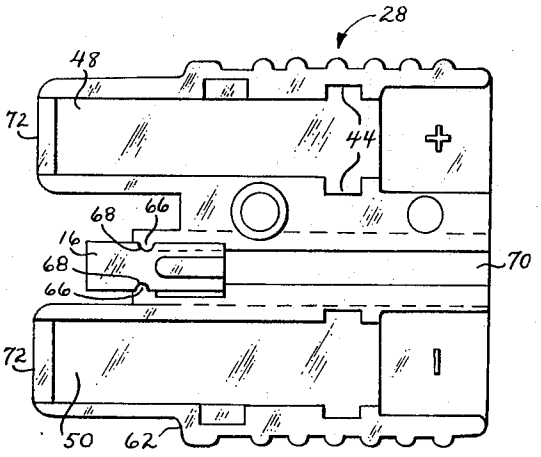


FIG. 3a

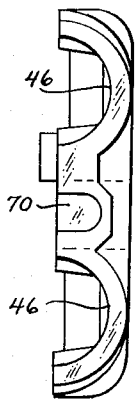


FIG. 3c

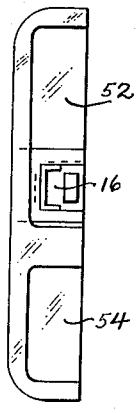


FIG. 4b

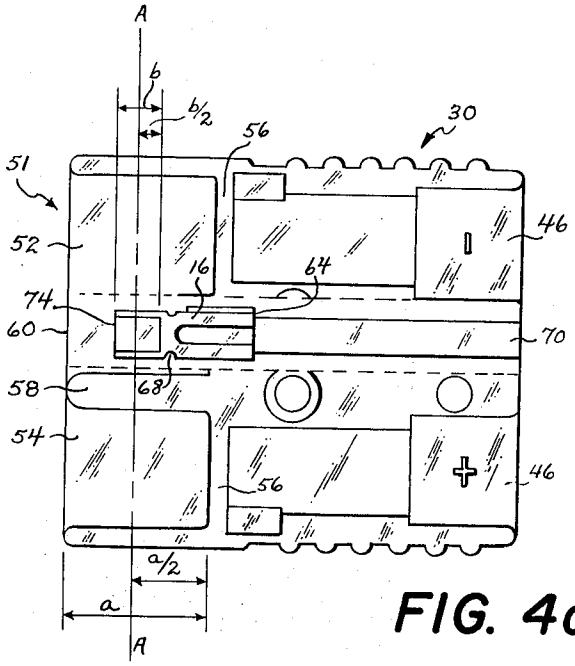


FIG. 4a

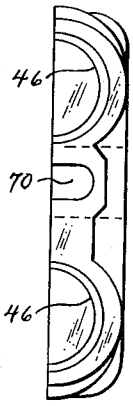


FIG. 4c

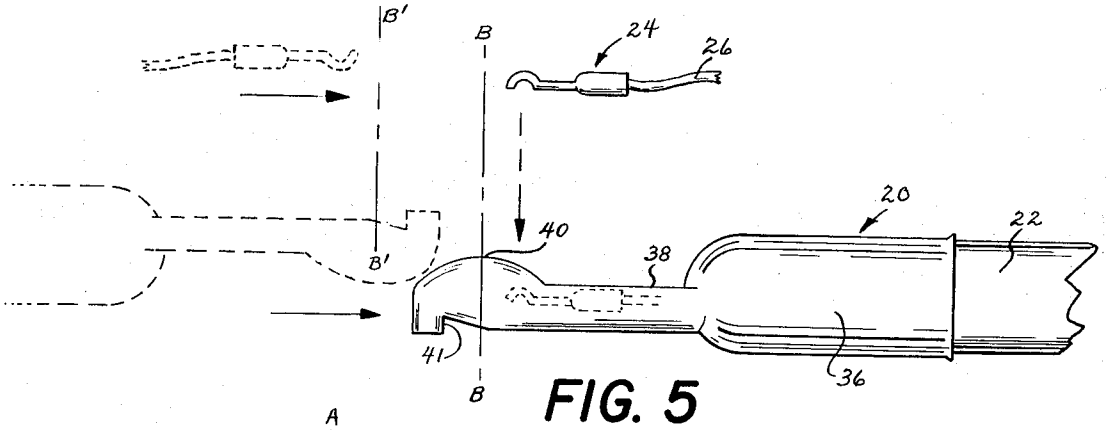


FIG. 5

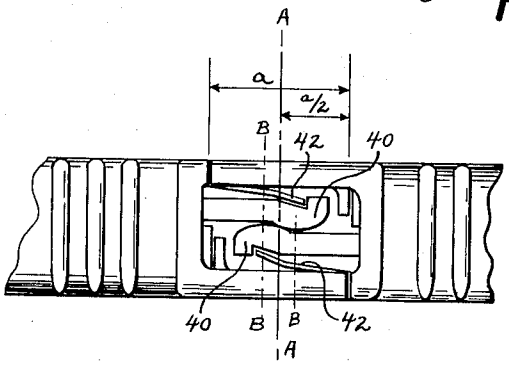


FIG. 6

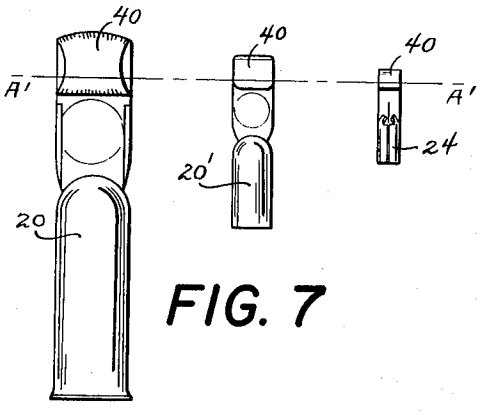


FIG. 7

PLURAL-POLED, GENDERLESS ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

The present invention relates to electrical connectors in general, and more particularly, to a plural-poled, genderless electrical connector.

Genderless electrical connectors are well known in the electric connector art. Representative examples of such connectors are shown in the following U.S. Pat. Nos. 3,091,746; 3,218,599; 3,259,870; and 3,654,586. The genderless type electrical connector has gained wide acceptance in the batterymotive industry for connecting and disconnecting the battery pack cables. Currently available genderless connectors include those manufactured and sold by Anderson Power Products, Inc., 145 Newton Street, Boston, Massachusetts 02135, under the United States Registered Trademarks SB and POWERPOLE.

In the batterymotive industry, electrical charging of the vehicle's battery pack is a relatively frequent and routine operation. The charger is electrically connected to the battery pack through the battery cable connectors. After the connection is made, the charger is turned on for a predetermined period of time or until the battery pack reaches a fully charged state. The charger is then turned off and disconnected from the battery cable connector.

It is desirable to make and break the electrical connections between the charger and the battery pack during a zero current or de-energized condition. Although the de-energized making and breaking of the charger-battery cable electrical connections can be achieved through manual operation of the charger, such an operation is susceptible to human error. It is, accordingly, one of the objects of the present invention to provide an electrical connector having main and auxiliary or control contacts which can be employed to control the operation of a battery charger. The sequence of operation for connecting the charger to its battery pack is as follows: (1) the main contacts close in a de-energized condition; (2) the auxiliary contacts close; (3) a relay within the charger controlled by the auxiliary contacts closes; and (4) the charger is energized and connected to the battery pack through the previously closed main contacts. The sequence for disconnecting the charger is as follows: (1) the auxiliary contacts open; (2) the relay controlled by these contacts opens; (3) the charges is de-energized; and, (4) the main contacts open in a de-energized condition.

BRIEF DESCRIPTION OF THE INVENTION

It is a general object of the present invention to provide a plural-poled, genderless electrical connector having main and auxiliary contacts which telescopically engage with counterpart contacts in an identical connector.

It is a specific object of the present invention to provide a plural-poled, genderless electrical connector in which the main contacts are arranged to provide a make first-break last electrical connection sequence while the auxiliary or control contacts are arranged to provide a make last-break first electrical connection sequence.

It is another object of the invention to provide a plural-poled, genderless electrical connector in which the contacts are positioned to provide a staggered peak insertion force load.

It is a feature of the invention that the electrical connector of the present invention comprises a combination of two presently existing electrical connectors.

It is another feature of the present invention that the components of the electrical connector can be assembled easily and that the electrical contacts can be electrically secured to the connector cables before the contacts are inserted into the electrical connector.

According to the preferred embodiment of the invention, a plurality of electrical connectors of the type described in U.S. Pat. Nos. 3,218,599 and 3,259,870 are positioned within and held by a modified electrical connector of the type described in U.S. Pat. Nos. 3,091,746.

DETAILED DESCRIPTION OF THE DRAWINGS

The objects and features of the present invention set forth above and other objects and features of the invention will best be understood from a detailed description of a preferred embodiment thereof, taken for purposes of illustration and shown in the accompanying drawings, in which:

FIG. **1** is a perspective view of a pair of identical, genderless, plural-poled electrical connectors in accordance with the preferred embodiment of the invention;

FIG. **2** is a plan view of the inner-housing portion of one of the identical connectors of FIG. **1** showing the spring biasing means for two rigid electrical contacts, one of which is illustrated in FIG. **2**;

FIGS. **3***a*, **3***b* and **3***c*, are plan and end elevation views, respectively, of the inner-housing portion of one of the identical connectors shown in FIG. **1**;

FIGS. **4***a*, **4***b* and **4***c*, are plan and end elevation views, respectively, of the outer-housing portion of one of the identical connectors shown in FIG. **1**;

FIG. **5** is a diagrammatic view of two sets of mating electrical contacts showing the relative position of the electrical contacts in each set;

FIG. **6** is a view in side elevation partially broken away showing two electrical contacts in the fully inserted, closed position; and

FIG. **7** is a diagrammatic view of three electrical contacts illustrating their relative positions to achieve a common contact closed center line.

Turning now to the drawings and particularly to FIG. **1** thereof, there is shown in perspective view a pair of identical, four-pole, genderless, electrical connectors indicated generally by the reference numerals **10** and **12.** The connectors **10** and **12** are exact counterparts adopted for longitudinal telescopic engagement of their connecting ends indicated at **14** and **14'**, respectively. In the preferred embodiment of the invention, the plural-poled, genderless electrical connectors **10** and **12** comprise a combination of the electrical connectors shown and described in U.S. Pat. Nos. 3,091,746 and 3,259,870. The electrical connector described in U.S. Pat. No. 3,259,870 is identified in FIGS. **1** through **4** of the drawings at **16,** generally. The electrical connectors **16** are positioned within a modified housing **18** of the electrical connector described in U.S. Pat. No. 3,091,746. Reference to these two United States Letters Patents should be made in connection with the following description of a preferred embodiment of the invention.

The connectors **10** and **12** each have a pair of electric cable terminals or contacts **20** which are electrically secured to corresponding cables **22.** The connectors also contain a pair of the previously mentioned separate connectors **16** each of which in turn contains a cable terminal or contact **24** which is electrically secured to a corresponding cable **26.**

The interrelationship between the superposed electrical connectors **16** and the electrical connector housing **18** can best be understood by referring to FIGS. **2** through **4** in conjunction with the perspective view of the connectors shown in FIG. **1.** In the preferred embodiment of the invention, the connector housing **18** comprises an insulated housing which is split longitudinally into two sections: an inner housing **28** shown in FIGS. **2** and **3**; and, an outer housing shown in FIG. **4.** The two housings are detachably connected together by means of bolts **32** and nuts **34** as shown in FIG. **1.**

The insulated housings **28** and **30** are arranged to support two identical rigid contact or terminal members **20.** For purposes of clarity, one contact member **20** has been removed from the inner housing **28** depicted in FIG. **2.** Each contact **20** is provided with a cylindrical end portion **36** which is bored to receive the end of an electrical cable, such as, cable **22.** The contacting end of each terminal **20** comprises an elongated flat portion **38** substantially rectangular in cross section and provided with a rounded or convex end portion **40** projecting from one surface thereof. The opposite face of the contacting end of each terminal is provided with a laterally extended shoulder portion forming a notch **41** (see FIG. **5**) arranged to be engaged by the inner end of an elongated, U-shaped leaf spring **42** (see FIG. **6**). The U-shaped spring **42** is held within the housing in opposed grooves **44** formed within the housing. Each housing also has two hollowed out, semicircular body portions **46** which form circular opening in the assembled connector through which the cables **22** exit from the connector.

The inner housing **28** is provided with two spaced, forwardly extending terminal receiving pockets **48** and **50** which are substantially U-shaped in cross section and closed at their outer end. The pockets **48** and **50** are aligned with their respective cable openings formed by the semicircular grooves **46.**

The outer housing portion **30** is provided with a corresponding, forwardly extending portion **51** that is coextensive with the body portion of the housing and shaped to provide two inverted U-shaped sockets **52** and **54.** The dockets are open at their outer ends and closed at their inner ends by transversely extending wall protions **56.** A longitudinally extending wall portion **58** separates the two sockets.

When the two housings are assembled as shown in FIG. **1,** the socket forming extension of the outer housing **30** extends over the terminal receiving pockets **46** and **48** of the inner housing **28.** The sockets **52** and **54** are sized to snugly receive the corresponding pockets **48** and **50** of a second and identical connector. Thus, in the assembled form the contacting end of each terminal is enclosed in its respective pocket except for the engaging face thereof which is resiliently urged by the leaf spring **42** toward the cooperating terminal. When the two connectors are telescoped together in longitudinal engagement as indicated by the dashed lines in FIG. **1,** the insertion distance is limited by the engagement of the outer housing end portion **60** with a shouldered portion **62** in the inner housing **28.**

The preceding description has been directed to the components of the present invention which are common with the components of the electrical connector described in U.S. Pat. No. 3,091,746. It has already been mentioned that the preferred embodiment of the present invention comprises a combination of the electrical connector shown in U.S. Pat. No. 3,259,870, and the connector shown in the previously mentioned U.S. Pat. No. 3,091,746. However, in order to accommodate the electrical connectors **16** within the connector housing **18,** the inner and outer housings **28** and **30** have been modified with respect to the corresponding housings shown in said U.S. Pat. No. 3,091,746.

Referring to said patent and the drawings of the present application, it can be seen that the central portion of the inner and outer housing **28** and **30** has been altered to accommodate the electrical connectors **16.** Specifically, the transverse distance between the extensions which form the terminal receiving pockets **46** and **48** has been increased to provide room for the electrical connectors **16.** In the modified version, each housing has a socket **54** which has the same configuration and size in plan view as the electrical connector **16.**

Looking at FIG. **2,** it can be seen that the inner housing **28** has a pair of transversely extending projections **66** which cooperate with corresponding notches **68** in the connector **16.** The combination of the housing projection **66** and notches **68** serve to accurately position the connector **16** for telescopic engagement with an identical connector and hold the connector within the inner housing **28.**

Each of the housings **28** and **30** has a longitudinally extending, semicircular cable receiving groove **70** for the connector cables **26.** The main contact cable receiving grooves **46** and the auxiliary contacts cable receiving groove **70** greatly simplify the assembly of the plural-poled connector of the present invention.

A number of different assembly sequences are possible given the split half configuration of the electrical connectors **10** and **12.** For example, the connectors **16** can be positioned within each of the respective inner and outer housings **28** and **30** before the housings are bolted together by means of bolts **32.** Thereafter, the pre-assembled main connector contacts **20** and cables **22** can be inserted into the connector from the rear through the annular passageways defined by the semicircular grooves **46.** In a similar manner, an auxiliary contact cable assembly comprising contacts **24** and cables **26** can be inserted into the electrical connectors **16** through the passage formed by the semicircular grooves **70.** Alternatively, each of the respective contact-cable assemblies can be formed and inserted into the respective housings before the inner and outer housings **28** and **30** are bolted together.

Although the preceding description has been directed to the split housing configuration of the preferred embodiment, it should be understood that the present invention is not limited to an electrical connector having separate inner and outer housings **28** and **30.** For example, the two housings can be combined into a single molded unit as depicted in FIG. **6.** However, a different contact biasing spring and spring holding arrangement must be employed in the single housing version of the present invention.

One suitable configuration for the contact biasing springs **46** and **48** for a single housing version of the present invention is described in U.S. Pat. No. 3,259,870. In that patent, the spring is T-shaped in plan view and slides into the single housing from the rear through the cable receiving channel. Means disclosed in the patent are provided for securing the contact spring in position within the housing. This arrangement is suitable for use in the present invention and is the preferred embodiment thereof for a single piece housing.

If a single piece housing is used, the receiving sockets **64** are modified by eliminating the projection **66** so that the electrical connector **16** can be inserted into the housing from the contacting end **14.** The electrical connectors **16** are held within the single piece housing by staking or by using a pin member (not shown) which extends through the housing and is positioned within the connector notches **68.**

It has already been mentioned that one of the objects of the present invention is to provide a plural-poled, genderless electrical connector having make first-break last main contacts and auxiliary contacts which make last and break first. This particular electrical sequence is obtained in connectors **10** and **12** by means of the configuration of the main and auxiliary electrical contacts and by relative positions of the contacts with respect to each other and to the connector housing **18** and the connector **16.**

The relative positions of the contacts **20** and **24** can best be understood by looking at FIGS. **2, 4***a*, **5, 6** and **7.** Referring first to FIG. **2,** the distance from the connecting end **72** of the forward extension which forms pockets **46** and **48** back to the shoulder **62** is identified by the small letter *a*. The dashed line in FIG. **2** indicates a distance from shoulder **62** equal to one-half the distance *a*. The distance *a* equals the insertion distance for the connectors **10** and **12** when they are inserted together in telescopic engagement. It should be noted that the *a*/2 distance dashed line does not intersect the center portion of the convex or crowned area **40** of the contact **20.**

Looking now at FIG. **4,** the outer housing **30** has similar distance relationships for its components. Thus, the distance from the outer housing forward end **60** to the forward surface of the transverse wall **56** is equal to the previously mentioned distance *a*. The center line A—A is positioned at a distance of *a*/2.

A similar configuration is also employed for the smaller connector **16.** The distance from the forward end **74** back to shoulder **76** (see FIG. **1**) is equal to a distance *b* which corresponds to the insertion distance for the connectors **16.** The center line A—A is located at a distance *b*/2 from the shoulder **76.**

Referring now to FIGS. **5** and **6,** the center line of the crowned convex portion **40** of each contact **20** is indicated by the dashed line B—B. It should be noted that the contact crown center line B—B does not correspond to the housing center line A—A which is located back from the connecting end of each housing by distance equal to one-half the connector insertion distance, i.e., distance *a*/2 . In FIG. **5,** the smaller contact **24** has been moved upwardly from the dotted position to the solid line position for purposes of clarity. It can be seen from an inspection of FIG. **5** that the smaller contact **24** is located behind the crown center line B—B of the larger contact **20.**

When the two connectors are inserted into each other in longitudinal telescoping engagement as shown in FIG. **6,** the final contact point for the two connectors **20** is defined by the center line A—A which is located exactly one-half of the distance *a* from the forward end **60** to the transverse wall **56.** If a plurality of different size contacts are arranged as shown in FIG. **7** with their respective closed contact positions being defined by the line A′—A′, this line will be located with respect to each individual connector at a distance equal to one-half of the insertion distance for the particular connector.

If three different size connectors are employed as shown in FIG. **7** in side-by-side or superposed relationship, the making electrical sequence will be in order, connector **20,** connector **20′** and connector **24.** Conversely, the breaking sequence will be connector **24,** connector **20′** and finally connector **20.** In the four-pole version of the present invention, the main contacts **20** make first and break last while the auxiliary contacts **24** make last and break first. The sequential making and breaking of the electrical connectors, each of which is spring biased as discussed above, provides for a staggered peak insertion force thereby facilitating the insertion of one connector into another connector and the subsequent separation of the mated connectors.

Having described in detail a preferred embodiment of my invention, it will now be apparent to those skilled in the art that numerous modificatons can be made thereto without departing from the scope of the following claims. For example, more than two main contacts **20** can be employed as well as other numbers of auxiliary contacts **24** and the current carrying capacities of each can also be varied to accommodate a particular situation.

What I claim and desire to secure by Letters Patent of the United States is:

1. A plural-pole, genderless electrical connector comprising:

1. a first hollow insulated housing means having:
   a. first and second rigid terminal members positioned within said first housing means and carried in detached relation to the walls thereof, said first and second rigid terminal members being adapted for telescopic engagement with corresponding first and second rigid terminal members of a duplicate genderless electrical connector; and,
   b. means for spring biasing said first and second rigid terminal members
2. a second hollow insulated housing means having:
   a. a third rigid terminal positioned within said second housing means and carried in detached relation to the walls thereof, said third rigid terminal member being adapted for telescopic engagement with a corresponding third rigid terminal member of a duplicate genderless electrical connector; and,
   b. means for spring biasing said third rigid terminal member
3. means for securing said second hollow housing means with respect to said first hollow housing means with said rigid terminal members being positioned to provide a make first-break last sequence for said first and second rigid terminal members and a make last-break first sequence for said third

rigid terminal when said rigid terminals are telescopically engaged with corresponding rigid terminals in a duplicate, genderless electrical connector.

2. The electrical connector of claim **1** further comprising:

1. a third hollow insulated housing means having:
   a. a fourth rigid terminal positioned within said third housing means and carried in detached relation to the walls thereof, said fourth rigid terminal member being adapted for telescopic engagement with a corresponding fourth rigid terminal member of a duplicate genderless electrical connector; and,
   b. means for spring biasing said fourth rigid terminal member
2. means for securing said third hollow insulated housing means with respect to said second hollow insulated housing means.

3. The electrical connector of claim **2** wherein said second and third hollow insulated housing means are secured with respect to each other so that said third and fourth rigid terminals make and break together when said rigid terminals are telescopically engaged with corresponding rigid terminals in a duplicate genderless electrical connector.

4. The electrical connector of claim **1** wherein at least a portion of said second insulated housing means is positioned within said first insulated housing means.

5. The electrical connector of claim **1** wherein said first hollow insulated housing means comprises detachable inner and outer housings and means for detachably securing said housings together and wherein at least a portion of said second hollow insulated housing means is positioned within and between said inner and outer housings and held thereby when said housings are secured together.

6. The electrical connector of claim **3** wherein said second and third insulated housing means are secured with respect to each other in superposed relation.

7. The electrical connector of claim **3** wherein said second and third insulated housing means are secured with respect to each other in side-by-side relation.

8. The electrical connector of claim **1** further comprising:

1. a third hollow insulated housing means having:
   a. a fourth rigid terminal positioned within said third housing means and carried in detached relation to the walls thereof, said fourth rigid terminal member being adapted for telescopic engagement with a corresponding fourth rigid terminal member of a duplicate genderless electrical connector; and,
   b. means for spring biasing said fourth rigid terminal member
2. means for securing said third hollow insulated housing means with respect to said first hollow insulated housing means.

9. The electrical connector of claim **8** wherein said second and third hollow insulated housing means are secured with respect to the first hollow insulated housing so that said third and fourth rigid terminals make and break together when said rigid terminals are telescopically engaged with corresponding rigid terminals in a duplicate genderless electrical connector.

* * * * *